TREE HARVESTER TRUNK SEAL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application Serial No. 10/201,561 filed July 22, 2002, which is a continuation of application Serial No. 09/665,233 filed September 18, 2000, now U.S. Patent 6,463,725, issued October 15, 2002; which applications are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to harvesting systems, and more particularly, to harvesting systems having a sealing arrangement for maintaining the harvester a predetermined distance from the plant such that a seal is maintained between the harvester and one or more plants.

BACKGROUND

Mechanized harvesters are well known and provide several advantages over traditional manual harvesting methods. One of the advantages provided by mechanized harvesters is that the time required to remove and gather produce from each of the plants is significantly reduced. Likewise, the overall cost of removing and gathering the produce from each of the plants is significantly reduced. Because of these advantages, the use of mechanized harvesters to harvest fruit, vegetables, or other produce from various plants, such as trees or vines, has increased considerably.

Despite these advantages, there can be disadvantages associated with the use of mechanized harvesters. One of the disadvantages associated with mechanized harvesters is the potential to lose produce as it falls to the ground while the harvester advances through the field. To minimize the amount of produce that falls to the ground, however, many mechanized harvesters currently exist that have been equipped with

conveyor systems that are positioned beneath the foliage of the tree or plant being harvested. These conveyor systems are constructed and arranged to catch produce as it falls from the plant and move it to a larger storage bin located on or adjacent to the harvester.

However, these conveyors are typically rigidly affixed to the harvester. Thus, in order for the conveyor to maintain a position proximate to the tree or plant to minimize the amount of produce lost, the operator is typically required to continuously adjust the path of the harvester. As a result, the distance between the harvester and the tree varies as the harvester advances.

In one scenario, as the distance between the harvester and the tree line increases, the amount of produce lost is also increased. Thus, the overall efficiency and cost-savings is reduced. In another scenario, as the distance between the harvester and the tree line decreases, the potential for damage to the harvester and/or the trees is increased.

Improvements in harvesters and seals used to maintain a seal between a first object and a second object are sought.

SUMMARY OF THE DISCLOSURE

The present disclosure generally relates to an apparatus for maintaining a seal between a first object and a second object. More particularly, the present disclosure is directed towards an apparatus for maintaining a first object a predetermined distance from a second object such that a seal is maintained between the first object and the second object.

In one aspect, the device comprises a retractable arm mounted to and extending from the first object towards the second object. The retractable arm is selectively positionable between at least a first position and a second position. The device also comprises a sealing arrangement mounted at a distal end of the retractable arm. The sealing arrangement includes a sealing member and a sensor configured to

engage the second object and provide input to the retractable arm so as to maintain a predetermined distance between the distal end of the retractable arm and the second object. As a result, a seal is formed and maintained between the first object and the second object.

In one aspect, the sealing member comprises a plurality of overlapping pivot plates pivotably mounted at the distal end of the retractable arm. The overlapping pivot plates are further constructed and arranged to accommodate the second object as the first object travels along a first direction. Furthermore, in this aspect, the sensor comprises a sensor bar extending along the width of the distal end of the retractable arm. The sensor bar is configured to engage the second object as the first object travels along a first direction.

In an alternative aspect, the sealing member and the sensor comprise a plurality of overlapping pivot plates pivotably mounted at the distal end of the retractable arm. In this aspect, the plurality of overlapping pivot plates are constructed and arranged to accommodate the second object as the first object travels along a first direction.

The disclosure also relates to a harvester for gathering product from one or more plants. The harvester comprises a drive mechanism for automatically advancing the harvester along a first direction relative to the plants. A retractable arm or conveyor is mounted to and extends from the drive mechanism towards the plant. The retractable arm is selectively positionable between a first position and a second position. Furthermore, the harvester also comprises a sealing arrangement mounted at a distal end of the retractable arm. The sealing arrangement includes a sealing member and a sensor configured to engage the plants and provide input to the retractable arm so as to maintain a predetermined distance between the distal end of the retractable arm and the second object. As a result, a seal is formed between the harvester and each of the plants.

The harvester can also comprise an agitator constructed and arranged to engage the plants and remove produce from the plant as the harvester moves in the first direction. In this aspect, the agitator comprises at least one whorl arrangement capable of rotating and engaging the plants to forcibly remove produce from the plant as the harvester moves in the first direction. Each of the whorls are capable of rotating about a vertical axis substantially perpendicular to the ground surface about which the harvester travels. Furthermore, each of the whorls are capable of reciprocating in a linear motion substantially forward towards and backwards away from the plant being harvested.

In one aspect, the sealing member comprises a plurality of overlapping pivot plates pivotably mounted at the distal end of the retractable arm. The overlapping pivot plates are constructed and arranged to accommodate at least one of the plants as the harvester travels along a first direction. In this aspect, the sensor comprises a sensor bar extending from a distal end of the retractable arm. The sensor bar is configured to engage a lower portion of the plants as the harvester travels along a first direction.

In an alternative aspect, the sealing member and the sensor can comprise a plurality of overlapping pivot plates mounted at the distal end of the retractable arm. In this aspect, the plurality of overlapping pivot plates are constructed and arranged to accommodate a lower portion of the plants as the harvester travels along a first direction.

The above summary of the present invention is not intended to describe each illustrated embodiment or every implementation of the present invention. Other objects, features and advantages of the present invention will become more apparent in light of the following detailed description of exemplary embodiments thereof, as illustrated in the accompanying drawings.

BRIEF DESCIPTION OF THE DRAWINGS

The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

FIG. **1** is side-elevational view of a harvester for removing produce from a tree having a trunk seal in accordance with the present disclosure;

FIG. **2** is a top view illustrating the harvester for removing produce shown in FIG. **1**;

FIG. **3** is a side-elevational view illustrating a retractable arm for use with the harvester of FIG. **1** in accordance with the present disclosure;

FIG. **4** is an enlarged, side-elevational view illustrating a sealing arrangement disposed at a distal end of the arm of FIG. **3**;

FIG. **5** is a top view illustrating one possible embodiment of the retractable arm shown in FIG. **3**;

FIG. **6** is a top view illustrating a second possible embodiment of the retractable arm shown in FIG. **3**;

FIG. **7** is an enlarged, segmented, top view of the retractable arm shown in FIGS. **3** and **5** illustrating a sensor bar in an unactuated state;

FIG. **8** is an enlarged, segmented, top view of the retractable arm shown in FIGS. **3** and **5** illustrating a sensor bar in an actuated state;

FIG. **9** is an enlarged, segmented, top view illustrating one possible embodiment of the sealing arrangement in accordance with the present disclosure; and

FIG. **10** is an enlarged, segmented, top view illustrating a second possible embodiment of the sealing arrangement in accordance with the present disclosure.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to

limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

The present disclosure generally relates to an apparatus for maintaining a seal between a first object and a second object. More particularly, the present disclosure is directed towards an apparatus for maintaining a first object a predetermined distance from a second object such that a seal is maintained between the first object and the second object. While the present invention is not so limited, a more detailed understanding of the present invention will be gained through a discussion of the drawings in connection with the examples provided below.

As will become apparent from the discussion below in connection with the accompanying drawings, the present disclosure has particularized applicability to mechanized harvesters used to harvest produce from a plant or tree. However, it will be appreciated by those having skill in the art that the present disclosure is not limited to the specific embodiments discussed below. Rather, the present disclosure has general applicability to situations where it is desirable to maintain a seal between a first object and a second object.

Referring now to FIG. **1**, there is illustrated a harvester **100** operating adjacent to a plant **102**. By way of illustration, the plant **102** shown in FIG. **1** is a citrus fruit tree, such as an orange or grapefruit tree. However, it should be understood that the embodiment shown in FIG. **1** is generally applicable to a variety of plants and trees, including various fruit trees as well as plants growing against a support structure, such as grapevines, or other similar plants or trees.

In one embodiment, the harvester **100** comprises a drive mechanism, such as a farm tractor or other similar device capable of moving through a grove or orchard of fruit trees **102**. As will be described below, the harvester **100** is constructed

and arranged to harvest produce as it moves along through a grove of fruit trees **102**. In the embodiment illustrated in FIG. **1**, a single harvester **100** is shown. However, preferably the harvester **100** can work in conjunction with a second harvester (not shown) while harvesting produce from one or more trees **102** in cooperation with the harvester **100**. In this embodiment, each harvester **100** moves along a row of trees **102** at substantially the same rate and on opposite sides of the same tree **102**. As a result, each harvester **100** removes produce from about approximately half of the tree **102**.

A retractable arm **112**, such as a conveyor **112a**, is mounted to the harvester **100**. The retractable arm **112** has a proximal end portion **118** at or near a first side **100a** of the harvester **100**. Similarly, the retractable arm **112** has a distal end portion **116** opposite the proximal end portion **118** at or near a location furthest away from the proximal end portion **118**. The retractable arm **112** is pivotably mounted to the harvester **100** at point **117** located substantially near or at a second side **100b** of the harvester **100**. The retractable arm **112** is mounted at point **117** using a pin and channel arrangement (not shown) as is commonly understood in the art. As a result, the retractable arm **112** is able to pivot about point **117** and slide up and/or down as the retractable arm **112** is extended or retracted as explained below.

As shown in FIG. **1**, the retractable arm **112** extends away from the harvester **100**, such that it can extend beneath the foliage of the tree **102**. The retractable conveyor **112** is selectively positionable between a first position and a second position. In the first position, for example, the retractable arm **112** is fully extended. In the second position, the retractable arm **112** is fully retracted. Typically, the distance the retractable conveyor or arm **112** extends from the harvester **100** varies according to the spacing between the distance between each row of trees **102** in the orchard or grove. For example, the retractable arm or conveyor **112** is positionable such that the distal end portion **116** of the retractable arm **112** can be at least about 8 feet (about 2.4 meters), no more than about 13 feet (about 4.0 meters), and in a preferred embodiment approximately about 11 feet (about 3.4 meters) from the centerline **CL**

(FIG. 1) of the harvester **100**. Thus, in the preferred embodiment, the distance the retractable conveyor or arm **112** extends from the centerline **CL** of the harvester **100** is optimized for harvesting produce from in an orchard or grove having 24 foot spacing.

Similarly, the retractable arm **112** has an overall width from the first side **158** of the retractable arm **112** to the second side **159** of the retractable arm **112** suitable to catch produce from the tree **102** while minimizing the amount of lost produce. Thus, for example, if used for citrus fruit trees, such as tree **102**, the retractable arm **112** has a width of at least about 15 feet (about 4.6 meters), no greater than about 30 feet (about 9.1 meters), typically about 20-24 feet (about 6.1-7.3 meters), and in a preferred embodiment about 22 feet (about 6.7 meters). In this embodiment, the retractable arm **112** is typically wide enough to span beneath at least about one or more trees **102** arranged in a row substantially parallel with the direction of travel of the harvester **100** as is commonly the case in a grove or orchard.

The harvester **100** can remove the produce from the tree **102** by shaking and/or agitating the foliage of the tree **102** or in any other suitable method. For example, in one embodiment, a vertical support shaft **104** extends upwardly from the harvester **100**. By "upwardly," it is meant that in the orientation of the harvester **100** shown in FIG. **1**, the support shaft **104** extends above a platform (not shown) of the harvester **100** and away from and substantially perpendicular to the ground **124**. The vertical support shaft **104** can be centered on the harvester **100**. Alternatively, the vertical support shaft **104** can be offset to one side of the harvester **100** as shown in FIG. **1** to facilitate removal of the fruit or produce from a tree.

One or more arm members **106** are independently rotatably mounted to the support shaft **104**. Each of the arm members **106** has a proximal end portion **105** at or near its point of attachment to the support shaft **104**. Similarly, each of the arm members **106** has a distal end portion **107** opposite the proximal end portion **105** at or near a location furthest away from the point of attachment to the support shaft **104**.

An agitator **109** is mounted at or near the distal end portion **107** of each of the arm members **106**. The agitator **109** is constructed and arranged to engage the tree **102** and forcibly remove the fruit or produce from the tree **102** as the harvester **100** moves along a first direction adjacent to the tree **102**. In one embodiment, the agitator **109** includes one or more whorl arrangements **109a**. As shown in FIGS. **1** and **2**, each whorl arrangement **109a** is rotatably mounted at or near the distal end portion **107** of each of the arm members **106**. Moreover, each whorl arrangement **109a** includes a first set of fingers **108** rotatably mounted above each arm member **106** and a second set of fingers **110** rotatably mounted below each arm member **106** as shown in FIG. **1**.

The first and second set of fingers **108, 110** are constructed and arranged to engage the tree **102**. For example, the first and second set of fingers **108, 110** are configured to rotate in plane substantially parallel to the ground surface **124** about which the harvester **100** travels. Similarly, the first and second set of fingers **108, 110** are capable of reciprocating in a linear motion along a direction of travel from the proximal end **105** to the distal end portion **107** of each arm member **106**. As a result, the whorl arrangement agitates the foliage of the tree **102** to forcibly remove the fruit from the foliage of the tree **102** as the harvester **100** advances in a first direction adjacent to the tree **102**.

A sealing arrangement **114** is provided at the distal end **116** of the retractable arm or conveyor **112** to maintain a seal between the harvester **100** and the tree **102**. Specifically, the sealing arrangement **114** maintains the distal end **116** of the retractable conveyor **112** a predetermined distance from a lower portion or trunk **120** of the tree **102**. As a result, a seal is maintained between and the tree trunk **120** the distal end **116** of the retractable arm **112**.

The sealing arrangement **114** includes a sealing member and a sensor configured to engage the lower portion or trunk **120** of the tree **102**. By "engage," it is meant that the sensor contacts or comes into close association or connection with the lower portion or trunk **120** of the tree **102**. In so doing, the sensor is capable of

controlling the retractable arm **112** such that a seal is maintained between the harvester **100** and the trunk **120** of the tree **102**. As a result, the amount of produce or fruit lost during harvesting is minimized. Furthermore, the operator of the harvester **100** is free to focus on advancing the harvester **100** through the grove or orchard of trees **102**. The sealing arrangement **114** will be discussed in greater detail below in conjunction with FIG. **4**.

Referring now to FIG. **3**, a side-elevational view of the retractable arm **112** is shown. The illustrated retractable arm **112** is generally rectangular and extends away from the harvester **100** and beneath the foliage of the tree **102**. FIG. **5** illustrates a top view of the retractable arm **112**. The retractable arm **112** has a first side **158** and a second side **159** opposite the first side **158**. In one embodiment, the retractable arm **112** can be generally comprised of one or more sections **161**, **162**, **163**, **164**, **165** that span the width of the retractable arm or conveyor **112** from the first side **158** to the second side **159**. In this embodiment, each of the sections **161**, **162**, **153**, **164**, **165** can include one or more individual, collapsible panels. For example, conveyor section **161** includes individual, collapsible panels **161a**, **161b**, **161c**, **161d**, and **161e**. The individual, collapsible panels **161a**, **161b**, **161c**, **161d**, and **161e** collapse longitudinally along the length of the retractable arm **112** from the proximal end portion **118** to the distal end portion **116**. As a result, the retractable arm **112** can telescopically extend or retract longitudinally along the length of the retractable arm **112** from the proximal end portion **118** to the distal end portion **116**.

In an alternative embodiment, the retractable arm **112** can be comprised of a singe section without individual, collapsible panels as described above. In this embodiment, the retractable arm **112** is configured to selectively extend or retract longitudinally along the length of the retractable arm **112** in a non-telescopically fashion.

In the embodiment shown in FIG. **5**, the arm **112** is extended and/or retracted using a hydraulic motor **136** that drives a chain **134** coupled to at least one

sprocket (not shown) disposed at the proximal and distal end portions **116, 118** of the arm **112**. The chain **134** extends the length of the retractable conveyor **112**. Furthermore, a second hydraulic motor and chain assembly can be situated along the second side **159** of the arm **112**. In so doing, the arm **112** can be extended or retracted evenly. However, it should be understood that the hydraulic motor and chain arrangement can be arranged at any location suitable to extend or retract the arm **112**. For example, the hydraulic motor and chain arrangement can be arranged beneath the arm **112**.

In an alternative embodiment shown in FIG. **6**, the arm **112** is extended and/or retracted using one or more hydraulic cylinders **172, 174** coupled to proximal and distal end portions **116, 118** of the arm **112** (FIG. **3**). In the embodiment shown, the hydraulic cylinders **172, 174** are arranged along the first and second sides **158, 159** of the arm **112**. However, it should be understood that the hydraulic cylinders **172, 174** can be arranged in any position suitable to extend or retract the arm **112**. For example, at least two phased hydraulic cylinders can be positioned along the first and second sides **158, 159** of the arm **112**. In still yet another embodiment, one or more hydraulic cylinders **172, 174** can be arranged above or beneath the arm **112**. Preferably, where more than one hydraulic cylinder is used to extend or retract the retractable arm **112**, the hydraulic cylinders **172, 174** can be phased hydraulic cylinders, such as those manufactured by Prince Manufacturing Corporation located in North Sioux City, South Dakota. In so doing, the arm **112** can be extended or retracted evenly.

Using either the hydraulic motor **136** and chain **134** assembly or the hydraulic cylinders **172, 174**, the arm **112** can be selectively extended or retracted. For example, in the embodiment illustrated in FIGS. **5** and **6**, as the arm **112** extends, the overlap between the individual, collapsible panels of each of the conveyor sections **161, 162, 163, 164**, and **165** is decreased. Conversely, as the arm **112** retracts, the overlap between the individual, collapsible panels of each of the conveyor sections **161, 162, 163, 164**, and **165** is increased.

The retractable arm or conveyor **112** has at least one height control gauge **122** configured to allow the retractable arm or conveyor **112** to move along the ground **124** at a preferred height with the harvester **100**. In the embodiment shown in FIG. **3**, the height control gauge **122** is constructed as a wheel having a cylindrical center portion **122a**, and two opposed frustro-conical end portions **122b**, **122c**. However, it will be understood that the height control gauge **122** can have any shape, including the shape of a convention cylindrical wheel or a spherical wheel. The shape of the wheel **122** as shown in FIG. **3** allows the conveyor **122** to extend and retract with minimal resistance from the ground **124**.

Referring now to FIG. **4**, a sealing arrangement **114** is provided at the distal end **116** of the retractable arm **112**. The sealing arrangement **114** includes a sealing member **129** and a sensor **131** configured to engage the lower portion or trunk **120** of the tree **102**. By "engage," it is meant that the sensor **131** contacts or comes into close association or connection with the lower portion or trunk **120** of the tree **102**. In so doing, the sensor **131** is able to control the retractable arm **112**. By "control," it is meant that the sensor **131** is configured to provide input to either the hydraulic motor **136** or the hydraulic cylinders **172**, **174** to selectively extend and retract the retractable arm **112** in accordance with a pressure being applied to the sensor such that a seal is maintained between the harvester **100** and the tree trunk **102**.

In a first embodiment, the sealing member **129** includes a plurality of overlapping pivot plates or fish scale members **130**. By "overlapping," it is meant that the leading edge of each of the pivot plates are positioned above or beneath a rear edge of an adjacent pivot plate such that no gap exists between any two adjacent pivot plates. While the illustrated sealing member **129** includes a plurality of overlapping pivot plates, it should be understood that the sealing member **129** can be any suitable member for maintaining a seal between the distal end **116** of the retractable arm **112** and the tree **102**, such as a rubber seal member or a brush-like member having bristles that form a seal. The overlapping pivot plates **130** extend from the distal end **116** of the retractable

arm **112**. The pivot plates **130** are constructed and arranged to accommodate a desired object as the harvester **100** advances in a first direction. By "accommodate," it is meant that the pivot plates **130** cooperate to conform to the contour of the desired object, thereby forming a seal between the harvester **100** and the object. In the embodiment shown, the pivot plates **130** cooperate to conform to the contour of the tree trunk **120**, thereby forming a seal between the harvester **100** and the tree trunk **120**.

Furthermore, in this first embodiment, the sensor includes a sensor bar **132** extending from the distal end portion **116** and along the width of the retractable conveyor **112**. The sensor bar **132** is mounted at the distal end portion **116** of the retractable conveyor **112** by cooperating linkage arms **145** as shown in FIG. **4**. The sensor bar is generally a straight, flat or tubular member. It should be understood, however, that the sensor bar **132** is not intended to be limited to such arrangements and can generally take on any suitable configuration for engaging the tree trunk **120**. Preferably, the sensor bar **132** extends from the first end **158** of the conveyor **112** to the second end **159** of the conveyor **112**.

As shown in FIG. **5**, the sensor bar **132** has a leading end portion **132a** and a trailing end portion **132b**. In one embodiment, the leading end portion **132a** extends beyond the first end **158** of the conveyor **112** and the trailing end portion **132b** extends beyond the second end **159** of the conveyor **112**. Alternatively, sensor bar **132** can have a length approximately equal to about the width of the retractable arm **112**. The leading end portion **132a** defines an arcuate or curved region of the sensor bar **132**. Accordingly, as the harvester **100** advances along a row of trees, the leading end portion **132a** gradually engages an oncoming tree and decreases the tendency of the sensor bar to become snagged. Similarly, the trailing end portion **132b** defines an arcuate or curved region of the sensor bar **132**. As a result, as the harvester **100** advances along a row of trees, the trailing end portion **132b** gradually disengages the tree trunk **120**. Thus, the sensor bar **132** allows an operator to continuously drive the harvester **100** adjacent to the trees **102** within a predetermined distance such that the pivot plates **130**

maintain a seal with the trees **102**. Similarly, the sensor bar **132** also prevents damage to the pivot plates **130** as the harvester **100** advances along the trees **102**.

Preferably, the sensor bar **132** is mounted at the distal end portion **116** of the retractable arm **112** using at least about two (2) pairs of cooperating parallel linkage arms **145**. However, it will be understood by those having ordinary skill in the art that the number of cooperating parallel linkage arms **145** used to support the sensor bar **132** can be varied according to the weight and width of the conveyor **112** as well as other considerations. Each pair of cooperating parallel linkage arms **145** includes an upper linkage arm **144** and a lower linkage arm **146**. As shown in FIG. **4**, the lower linkage arm **146** is pivotably connected to the distal end portion **116** of the retractable arm **112** at pivot point **148**. As a result, the sensor bar **132** is able to pitch or rotate in relation to the distal end portion **116** of the arm **112**. Similarly, the plurality of overlapping pivot plates **130** can also pitch or rotate to guide the produce towards the conveyor or arm **112** as it falls from the tree **102**. Preferably, the sensor bar **132** is configured and arranged substantially perpendicular to the trunk **120**.

Moreover, the upper and lower linkage arms **144**, **146** are biased such that the sensor bar **132** is fully extended from the distal end portion **116** of the retractable arm **112**. For example, as shown in FIGS. **5** and **6**, a spring **170** biases the sensor bar **132** such that it is fully extended from the distal end portion **116** of the arm **112**. An adjustable chain (not shown) is provided to allow the distance or space between the sensor bar **132** and the distal end portion **116** of the arm **112** to be either increased or decreased so that the desired degree of sealing overlap can be set.

As shown in FIG. **8**, the upper and lower linkage arms **144**, **146** are constructed and arranged to allow the sensor bar **132** to move towards the distal end portion **116** when a force **F** (FIG. **8**) is applied to the sensor bar **132** in a direction towards the retractable conveyor **112**. The force **F** is typically applied to the sensor bar **132** as the sensor bar **132** engages the tree **102**. Accordingly, as the retractable arm **112** is moved closer to the tree **102**, the force **F** acting on the sensor bar **132** is increased.

Conversely, as the retractable arm **112** is moved away from the tree **102**, the force **F** acting on the sensor bar **132** is reduced. As shown, the linkage arms **144, 146** preferably are arranged such that they are not perpendicular to the distal end portion **116** when fully extended. Thus, when the sensor bar **132** engages the tree **102**, the upper and lower linkage arms **144, 146** can move towards the distal end portion **116** of the arm **112** with minimal resistance and strain on the sensor bar **132** and/or the linkage arms **144, 146**.

As can be seen in FIGS. **7** and **8**, a connecting member **156** mechanically couples the sensor bar **132** to a linkage rod assembly **152**. The linkage rod assembly **152** extends along the second end **159** of the arm **112**. However, it should be understood that the linkage rod assembly **152** and the connection member **156** can be arranged at any suitable location along the sensor bar **132**. Furthermore, the linkage rod assembly **152** is also coupled to an actuating assembly **154** that is configured to selectively extend or retract the arm **112**.

In one embodiment, the actuating assembly **154** includes a conventional micro switch, such as a solenoid switch that actuates the conveyor **112**. The actuating assembly **154** is selectively positionable between a first, second, and third or neutral state. In the first state, the actuating assembly **154** is triggered to retract the conveyor **112**. In the second state, the actuating assembly **154** is triggered to extend the conveyor **112**. In the third state (e.g., between the first and second states), the actuating assembly **154** is not triggered and the conveyor **112** is, therefore, not extended or retracted.

For example, as the sensor bar **132** is compressed by a force **F** (e.g. a tree **102**) as shown in FIGS. **8** and **9**, the linkage rod **152** urges the actuating assembly **154** into its first state to retract the arm **112**. The actuating assembly **154** provides input to either the hydraulic motor **136** or the hydraulic cylinders **172, 174**, thereby retracting the arm **112**. The arm **112** retracts until the arm **112** is completely retracted or until the actuating assembly **154** reaches its neutral state. The neutral state is achieved when a predetermined force is applied to the sensor bar **132** that allows the overlapping pivot

plate assembly **130** to form an adequate seal around the tree **120** without risking damage to the sensor bar **132** or the overlapping pivot plates **130**.

Conversely, as the arm **112** retracts, thereby reducing the force **F** exerted against the sensor bar **132**, the linkage rod **152** urges the actuating assembly **154** into its second state to extend the conveyor **112**. The actuating assembly **154** again provides input to the either the hydraulic motor **136** or the hydraulic cylinders **172, 174**. However, in this case, the hydraulic motor **136** or the hydraulic cylinders **172, 174** cause the conveyor **112** to extend. The conveyor **112** extends until the conveyor **112** is completely extended or until the actuating assembly **154** reaches its neutral state. As discussed above, the neutral state is achieved when a predetermined force is applied to the sensor bar **132** that allows the overlapping pivot plate assembly **130** to form an adequate seal around the tree **120** without risking damage to the sensor bar **132** or the overlapping pivot plates **130**.

As discussed above, the sealing arrangement **114** also includes a sealing member **129**. For example, in the embodiment illustrated in FIG. **9**, the sealing member **129** includes a plurality of overlapping pivot plates or fish scale members **130**. The overlapping pivot plates **130** are pivotably mounted at the distal end **116** of the retractable arm or conveyor **112**. The pivot plates **130** are constructed and arranged to accommodate a desired object as the harvester **100** advances in a first direction. By "accommodate," it is meant that the pivot plates **130** cooperate to conform to the contour of the desired object, thereby forming a seal between the harvester **100** and the object. A coil spring **150** is disposed beneath each of the overlapping pivot plates **130** (FIG. **4**). As a result, each of the overlapping pivot plates **130** are spring biased such that they extend away from the distal end **116** of the conveyor **112**.

Furthermore, as shown in FIG. **9**, the overlapping pivot plates **130** extend beyond the sensor bar **130**. Thus, as the harvester **100** advances adjacent to the trunk **120** of a tree, the sensor bar **132** engages or rubs against the trunk **120** of the tree. Similarly, the pivot plates **130** also engage the trunk **120** of the tree **102**. As can be seen

from FIG. **9**, the overlapping pivot plates **130** cooperate to form a seal against the tree trunk **120**. Preferably, the overlapping pivot plates **130** cooperate to form a seal about a centerline **L** of the tree **102**.

In a second embodiment illustrated in FIG. **10**, the sensor includes a rotary sensor or switch **176** as is commonly understood in art. In this embodiment, one or more rotary sensors or switches **176** can be coupled to a corresponding one or more of the pivot plates **130**. In this embodiment, the sensor bar **132** is not required. However, it will be understood by those of ordinary skill, that bar similar in construction to the sensor bar **132** can be used as a guard to protect the distal end **116** of the conveyor **112** as well as the pivot plates **130**.

Preferably, one or more of the overlapping pivot plates **130** are pivotably mounted at the distal end **116** of the conveyor **112** using a rotary switch **176**. The rotary switch **176** is coupled to an actuating assembly **154**, such as a micro switch, that is configured to selectively extend or retract the conveyor **112**. As discussed above, the actuating assembly **154** is selectively positionable between a first, a neutral, and a second state. The rotary switch **176** provides input to the actuating assembly **154** according to the angular displacement of the corresponding pivot plate. In the first state, the actuating assembly **154** is triggered to retract the arm **112**. In the neutral state, the actuating assembly **154** is not triggered and the arm **112** is, therefore, not extended or retracted. In the second state, the actuating assembly **154** is triggered to extend the arm **112**.

For example, as the harvester **100** advances adjacent to the tree trunk **120**, the leading edges **131** of the pivot plates **130** engages the tree trunk **120** as shown in FIG. **10**. The pivot plates **130** corresponding to the location of the tree trunk **120** are rotated. As the pivot plates **130** are rotated, the actuating assembly **154** is switched from its neutral state to its first state. Accordingly, the arm **112** is retracted.

Conversely, when all of the pivot plates **130** are fully rotated, the actuating assembly **154** is switched into its second state. Accordingly, the conveyor **112**

is extended. The arm **112** extends until it is fully extended or until the actuating assembly **154** is switched to its neutral state.

Moreover, as discussed above, the harvester **100** can work in conjunction with a second harvester (not shown) while harvesting produce from one or more trees **102**. In this embodiment, each harvester **100** moves along a row of trees **102** at substantially the same rate and on opposite sides of the same tree **102**. As a result, each harvester **100** removes produce from about approximately half of the tree **102**. Furthermore, the sealing arrangement **114** as described above forms and maintains a seal between each tree **102** and both harvesters **100** while advancing adjacent to the trees **102**, thereby minimizing the amount of produce lost.

As a result of this arrangement, the overlapping pivot plates **130** are able to form a seal between harvester **100** and the tree trunk **120**. More specifically, the overlapping pivot plates **130** form a seal between the distal end **116** of the conveyor **112** and a centerline **L** of the tree trunk **120**.

The above specification and embodiments are believed to provide a complete description of the manufacturer and use of particular embodiments of the invention. Many embodiments of the invention can be made without departing from the spirit and scope of the invention, which is limited by the attached claims.